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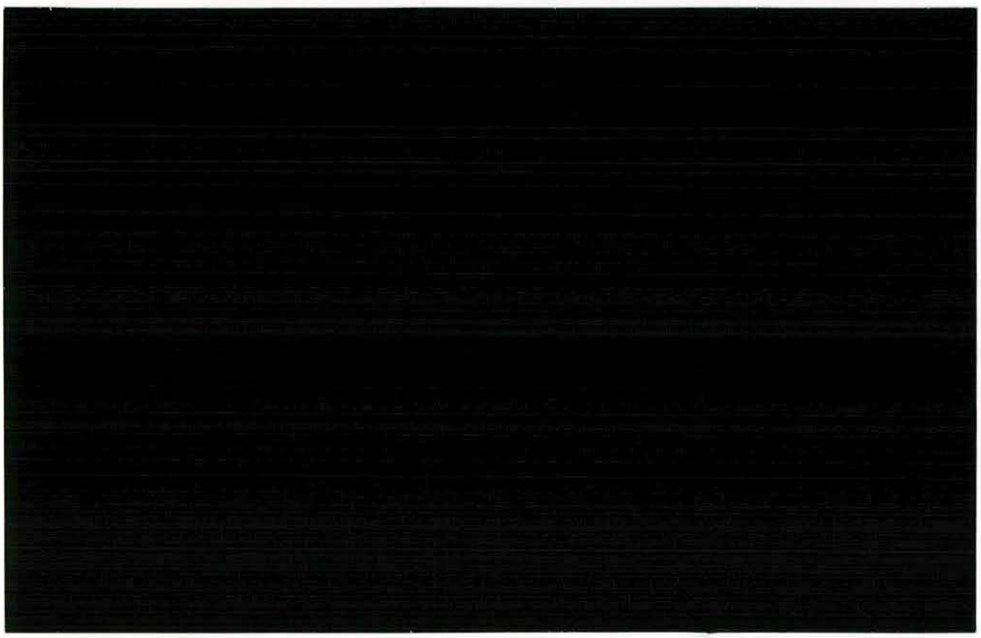

The Centre for Ecology and Hydrology has 600 staff, and well-equipped laboratories and field facilities at nine sites throughout the United Kingdom. The Centre's administrative headquarters is at Monks Wood in Cambridgeshire.

CEH Sites

CEH Directorate
Monks Wood, Abbots Ripton,
Huntingdon,
Cambridgeshire PE28 2LS
Telephone +44 (0) 1487 772400
Main Fax +44 (0) 1487 773590

CEH Oxford
Mansfield Road,
Oxford,
Oxfordshire OX1 3SR
Telephone +44 (0) 1865 281630
Main Fax +44 (0) 1865 281696

CEH Merlewood
Windermere Road,
Grange-over-Sands,
Cumbria LA11 6JU
Telephone +44 (0) 15395 32264
Main Fax +44 (0) 15395 34705

CEH Bangor
University of Wales, Bangor,
Deiniol Road,
Bangor, Gwynedd LL57 2UP
Telephone +44 (0) 1248 370045
Main Fax +44 (0) 1248 355365

CEH Wallingford
Maclean Building, Crowmarsh Gifford,
Wallingford,
Oxfordshire OX10 8BB
Telephone +44 (0) 1491 838800
Main Fax +44 (0) 1491 692424

CEH Dorset
Winfrith Technology Centre,
Winfrith Newburgh, Dorchester,
Dorset DT2 8ZD
Telephone +44 (0) 1305 213500
Main Fax +44 (0) 1305 213600

CEH Edinburgh
Bush Estate,
Penicuik,
Midlothian EH26 0QB
Telephone +44 (0) 131 4454343
Main Fax +44 (0) 131 4453943

CEH Windermere
The Ferry House, Far Sawrey,
Ambleside,
Cumbria LA22 0LP
Telephone +44 (0) 15394 42468
Main Fax +44 (0) 15394 46914

CEH Monks Wood
Abbots Ripton,
Huntingdon,
Cambridgeshire PE28 2LS
Telephone +44 (0) 1487 772400
Main Fax +44 (0) 1487 773467

CEH Banchory
Hill of Brathens,
Banchory,
Aberdeenshire AB31 4BY
Telephone +44 (0) 1330 826300
Main Fax +44 (0) 1330 823303

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Contract No.

INSTITUTE OF TERRESTRIAL ECOLOGY

MASQ: MONITORING AND ASSESSING SOIL QUALITY

NERC/DETR/EA funded : ITE Project Number T01069a5

Module 6: Soils and Pollution

Progress Report 1 to The Environment Agency

February 1999

Helaina Black
Soil Ecology Section
ITE Merlewood
Windermere Road
Grange-over-Sands
CUMBRIA LA11 6JU

Introduction and background

The Royal Commission on Environmental Pollution on Soil Sustainability (1996) identified the development of indices of soil biological activity and diversity as a key research priority. The major difficulty in developing such indices is the need for baseline data from which a set of standards can be developed. A recent review by ITE (SOILPACS, 1996) has shown that existing data are inadequate to develop bioindicators of soil quality, as the data are poorly structured and inconsistent in methodology and objectives. A nationwide survey is necessary if we are to establish a comprehensive baseline dataset. This task requires considerable logistical commitment, since soil biological sampling is meaningless without detailed site information. In addition, issues related to the contamination of soil by past, present and future economically valuable activity involving chemical use and disposal, are proving difficult to resolve in the absence of a framework of national information on soil contamination that is related to land use type.

Countryside Survey 2000 (CS2000) provides a cost-effective framework for integrating a soil biological survey with existing and subsequent soil and land use data status and for a comparison with soil data from the 1978 Countryside Survey (pH, loss on ignition, basic soil descriptions). The programme of sampling would be targeted to enable the CS2000 field surveyors to re-sample X-plots used for soil sampling in the 1978 survey (ca. 1280 sites). The surveyors would be trained to collect suitable soil material for subsequent laboratory evaluation of soil pH, carbon content, faunal and microbial diversity and soil heavy metal and organic contents.

2. Objectives

2.1 Overall Objectives:

To provide good quality information about chemical and biological soil properties to support a national survey of soil properties and improve understanding of links between soil biology, chemistry and the wider environment in order to support the development of suitable, effective strategies and policies relating to soil protection.

2.2 Specific Objectives

1 To provide a national overview of chemical and biological soil properties and a baseline against which specific sites can be compared by carrying out a programme of soil sampling, at the locations used in the CS2000, by the field surveyors operating under the CS2000.

2 To measure pH and soil carbon content and carry out a range of chemical analyses and a laboratory evaluation of faunal diversity and microbiological status to provide a baseline for the monitoring and assessment of soil quality in England and Wales.

3 To integrate information on chemical and biological properties and to look at it in terms of soil quality assessment and the wider terrestrial environment.

2.3 Objectives for 1998-99

Protocol development, training, sampling and immediate processing

- trials of sampling and transport methods suitable for sampling in a range of soil types;
- increasing the capacity of existing laboratory facilities;
- development of tailor made sampling kits;
- identification of appropriate existing, and development of new, protocols for field sampling and subsequent laboratory processing of samples.
- training of field survey teams;
- field sampling and return of samples to Merlewood;
- immediate sample processing and appropriate storage of samples;
- development and population of the database for soil acidity and loss on ignition (soil organic matter and carbon) and associated supporting data.
- short scoping study for the chemical properties work programme (ie for metals and organics), considering potential substances for inclusion, suitability of analytical methods, quality assurance methods to be employed and cost.

3 Progress

Staff

The full-time processing staff continued to receive and process the CS2000 cores as they arrived at ITE Merlewood and enter the weekly data from the log-in sheets onto an EXCEL spreadsheet. A third (part-time) member of staff verified the 1978 soils data and monitored the progress of the fieldwork. Dr Black completed the first progress report and an article for inclusion in the CS2000 web pages (http://www.cs2000.org.uk).

Field sampling

The CS2000 surveyors carried out the soil sampling to schedule and with few problems. Communication between the surveyors, co-ordinators and the samples processors meant that any outstanding sampling issues (e.g. numbering changes) were resolved quickly. The field sampling was completed by the end of October 1998 and the field equipment has being collected by the co-ordinators. This is being returned to ITE Merlewood along with the other CS2000 field equipment as transport is made available.

Sample processing and protocols

MASQ Laboratory

The renovated laboratory proved ideal for the processing of such a large number of samples. The soil faunal and microbial cores arrived at an average rate of 50 per week while the soil

chemistry cores arrived in larger numbers in a less regular manner since they were returned by the ITE co-ordinators when transport was available.

The last soil microbial and faunal cores were received on 28.10.98. All soil microbial samples are now frozen and accessible by date. The extraction of the last soil faunal core was completed on 2.11.98 and all faunal samples, in 70% ethanol, are now stored in according to square/X-plot in flammable cupboards at ITE Merlewood. The remaining cores for soil chemical analyses were received on 29.10.98 and are currently air-drying before analyses and storage. The remaining samples will be analysed by mid-November 1998. Soil for organics analyses are frozen as part of the soil microbial core. The methods for sampling from these cores for organics are currently being discussed with Dr D Osborn at ITE Monkswood.

Chemical Scoping Study

The specifications for this scoping study have been discussed between the Soil Ecology, Soil Ecotoxicology and Environmental Chemistry Sections at ITE Merlewood and ITE Monskwood. Dr Osborn will co-ordinate the organics section and Dr Black will co-ordinate the heavy metals section. The report on these will be completed by the end of March 1999.

4. Deliverables

1. Summary statistics regarding the number of samples expected and received from CS2000, by region, squares, soil type and ITE Land Class are presented in the following tables;

Table 1: Summary table of the number of soil samples, by region, expected and received from CS2000 for chemical analyses (pH, LOI and heavy metals), soil microbial assessments/ organic chemical analyses and soil zoological assessments. A further 125 samples will be obtained from Scotland during summer 1999.

Number of samples	TARGET	Chemistry	Microbial +Organics	Zoology	Chemistry %	Microbial +Organic %	Zoology %
England & Wales	725	633	629	630	87.31	86.76	86.90
Scotland	530	347	351	352	65.47	66.23	66.42
Total	1255	980	980	982	78.09	78.09	78.25

Table 2. Summary table of the expected and completed number of CS2000 squares sampled for soil by region and subsequent analyses required.

Complete squares (sets of 5)	TARGET	Chemistry	Microbial +Organics	Zoology
England & Wales	145	117	117	117
Scotland	106	57	57	57
Total	251	174	174	174

Table 3. Summary table of the number of soil samples, by soil type*, expected and received from CS2000 for chemical analyses (pH, LOI and heavy metals), soil microbial assessments/ organic chemical analyses and soil zoological assessments. *soil type from 1978 Countryside Survey data.

Soil type (1978)	Region	TARGET	Chemistry	Microbial +Organic	Zoology	Chemistry %	Microbial +Organic %	Zoology %
brown earth	England &Wales	330	282	278	279	85.45	84.24	84.55
peat	England & Wales	16	14	15	15	87.50	93.75	93.75
ranker	England & Wales	11	10	8	8	90.91	72.73	72.73
podzol	England & Wales	65	58	60	60	89.23	92.31	92.31
rendzina	England & Wales	20	18	18	18	90.00	90.00	90.00
gley	England & Wales	276	244	243	243	88.41	88.04	88.04
tba	England & Wales	7	7	7	7	100.00	100.00	100.00
brown earth	Scotland	123	83	82	83	67.48	66.67	67.48
peat	Scotland	124	88	88	88	70.97	70.97	70.97
ranker	Scotland	65	37	38	38	56.92	58.46	58.46
podzol	Scotland	102	75	76	76	73.53	74.51	74.51
gley	Scotland	111	61	62	62	54.95	55.86	55.86
tba	Scotland	5	3	5	5	60.00	100.00	100.00
TOTAL	All regions	1255	980	980	982	78.09	78.09	78.25

* tba = to be assigned

Table 4. Summary table of the number of soil samples, by ITE Land Class*, expected and received from CS2000 for chemical analyses (pH, LOI and heavy metals), soil microbial assessments/organic chemical analyses and soil zoological assessments. *standardised on 1990 ITE Land Classification.

ITE Land Class	Region	Target	Chemistry	Microbial +Organics	Zoology	Chemistry %	Microbial %	Zoology %
1	England & Wales	30	30	30	30	100.00	100.00	100.00
2	England & Wales	50	45	45	45	90.00	90.00	90.00
3	England & Wales	55	49	49	49	89.09	89.09	89.09
4	England & Wales	20	15	15	15	75.00	75.00	75.00
5	England & Wales	15	11	11	11	73.33	73.33	73.33
6	England & Wales	45	36	36	36	80.00	80.00	80.00
7	England & Wales	45	39	35	35	86.67	77.78	77.78
8	England & Wales	34	30	31	31	88.24	91.18	91.18
9	England & Wales	55	46	45	44	83.64	81.82	80.00
10	England & Wales	60	56	54	56	93.33	90.00	93.33
11	England & Wales	60	51	51	51	85.00	85.00	85.00
12	England & Wales	24	22	22	22	91.67	91.67	91.67
13	England & Wales	30	27	30	30	90.00	100.00	100.00
15	England & Wales	25	15	16	16	60.00	64.00	64.00
16	England & Wales	30	25	25	25	83.33	83.33	83.33
17	England & Wales	50	48	48	48	96.00	96.00	96.00
18	England & Wales	25	25	25	25	100.00	100.00	100.00
19	England & Wales	15	17	15	15	113.33	100.00	100.00
22	England & Wales	15	15	15	15	100.00	100.00	100.00
23	England & Wales	15	15	15	15	100.00	100.00	100.00
25	England & Wales	10	10	10	10	100.00	100.00	100.00
tba	England & Wales	17	7	7	7	41.18	41.18	41.18
7	Scotland	25	21	20	21	84.00	80.00	84.00
13	Scotland	15	15	15	15	100.00	100.00	100.00
18	Scotland	5	3	4	4	60.00	80.00	80.00
19	Scotland	5	5	5	5	100.00	100.00	100.00
21	Scotland	45	27	27	27	60.00	60.00	60.00
22	Scotland	35	27	27	27	77.14	77.14	77.14
23	Scotland	34	23	22	22	67.65	64.71	64.71
24	Scotland	40	28	28	28	70.00	70.00	70.00
25	Scotland	49	29	29	29	59.18	59.18	59.18
26	Scotland	39	17	18	18	43.59	46.15	46.15
27	Scotland	43	23	23	23	53.49	53.49	53.49
28	Scotland	40	24	24	24	60.00	60.00	60.00
29	Scotland	44	35	38	38	79.55	86.36	86.36
30	Scotland	35	15	15	15	42.86	42.86	42.86
31	Scotland	35	27	27	27	77.14	77.14	77.14
32	Scotland	30	25	24	24	83.33	80.00	80.00
tba	Scotland	11	2	4	4	18.18	36.36	36.36
	tba			9	9			
TOTAL	All regions	1255	980	980	982	78.09	78.08765	78.24701

* tba = to be assigned

2. The soils for chemical analyses (Table 1) have all had pH measured on a sub-sample of the initial sample, the remaining sample dried and ground and pH and loss on ignition (LOI) have been measured on the ground sample (Figures 1 and 2, respectively, summarise the number of samples analysed).

3. All soil biota samples (Table 1) are stored in preparation for the next stage of analyses: soil fauna have been extracted for all faunal soil cores and are now stored in 70% ethanol for identification. The samples for microbiological and organic analysis have all been frozen at □86°C.

4. Locational, data, pH and loss on ignition for all samples have been entered into an ACCESS database linked to the main CS2000 database. The information is also available by Land Class and country. The first stage of data verification has been carried out and all anomolies with square and plot numbers have been resolved. The requirements for user-access and data storage have been discussed with John Watkins (CS2000 Module 13) and, consequently, the best methods to integrate the MASQ data with the 1978 soils data and CS2000 survey data are being assessed.

5. Modifications to the MASQ extraction and preparation protocols for biotic and chemical analyses have been edited into the protocol sheets; see appendix for a copy

6. All current data (until 1.12.98) have been copied onto a CD-ROM which is now stored off-site. Further copies will be made on a regular basis.

7. Web page for MASQ completed (see Appendix).

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Figure 1. Number of Countryside Survey 2000 soil samples analysed for pH at ITE Merlewood from May 1998 to November 1998

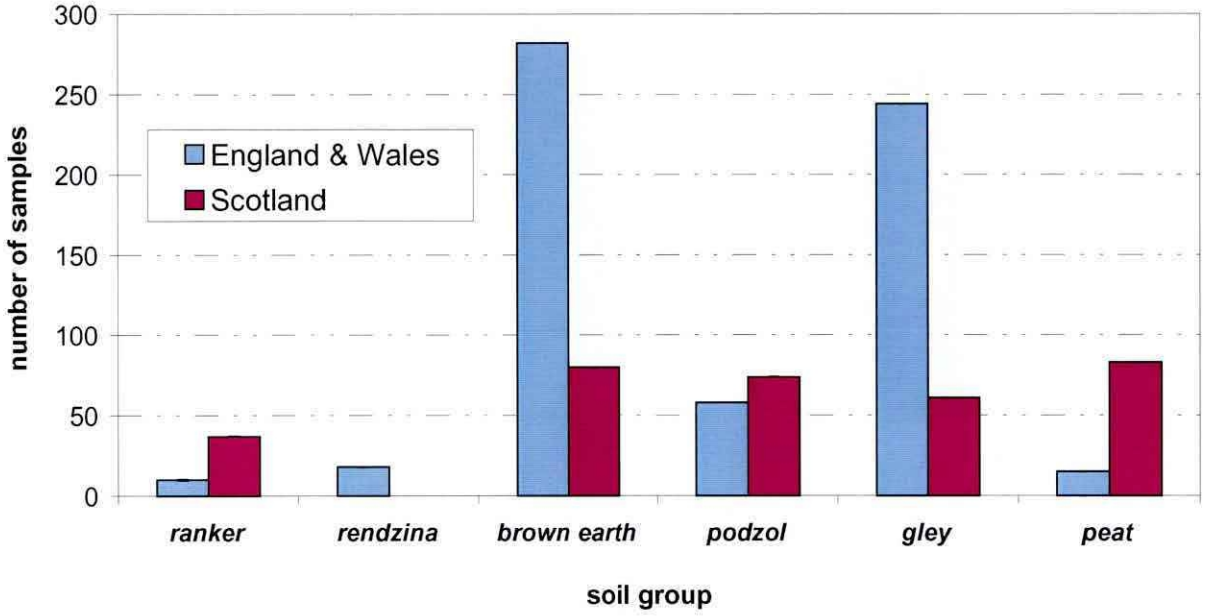
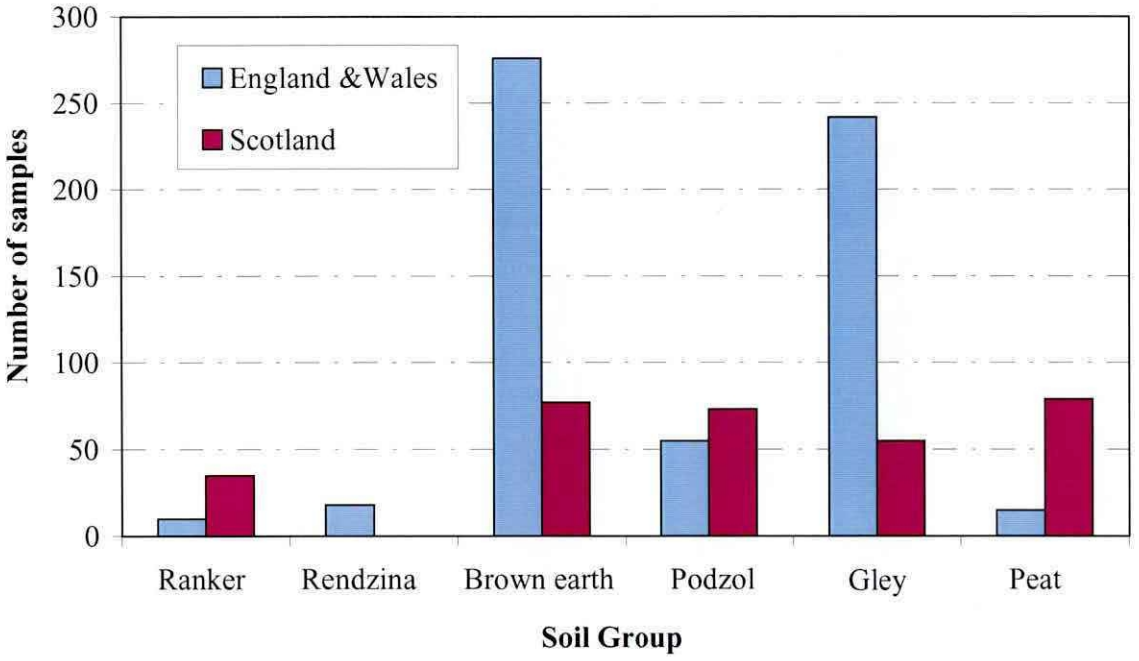


Figure 2. Number of Countryside Survey 2000 soil samples analysed for loss-on-ignition at ITE Merlewood from May 1998 - November 1998



Processing Protocols for CS2000 Soil Samples
Updated version from 1.12.98
and
WWW page for MASQ

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